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merely for those interested in determining ferns, and it stops precisely at the point where interest for the specialist begins.

Another principle in the selection of species has been to include those which are remarkable in structure, phylogenetic character, or biological peculiarity. Those genera which, as he says, "are weakly expressed, showing only one or a few disappearing species," he omits in favor of those which are rich in species and uniform in character. He also omits peculiar island types, such as those of the Sandwich islands, Madagascar, etc.; nor does he include the rich fern flora of the Andes. His contention is that a comprehensive monograph, with a critical catalogue of all species, would be a work of several volumes, and would not serve the general purpose he has in view. With all these restrictions he presents 99 genera and 1154 species.

No analytic keys are provided, but simple descriptions of genera, sections, and species are depended upon to guide sufficiently. The author claims that a safe key is only possible for a limited flora and small genera, and that the more inclusive the key the more unsafe does it become. The descriptions are exceedingly simple, technical terminology being avoided so far as possible.

An excellent feature of the book is to be found in the numerous illustrations in the text accompanying the descriptions. These illustrations show at a glance the characters described by the text. It would be a useful thing if American students of ferns had a translation of this handy and simple volume.—J. M. C.

Text-book of lichenology.[4]

IT IS so long since any work on lichens has been published by an American author that we take up Dr. Schneider's book with especial interest. In the preface we find this statement: "This work is primarily intended as a text-book for the use of students in colleges and universities, but will also be found useful to the specialist." Our secretly cherished hope that the study of lichens is to be popularized begins to fade away when we read that statement. As we glance over the technical treatment outlined for the subject, the hope entirely disappears. The book will be useful to those for whom it was written, but a feeling of regret will arise that it was not adapted for more general use. The plates, of which there are seventy-eight, add greatly to the value of the book, though it must be said that they are somewhat schematic. The subject-matter is divided into two parts. Part I treats of the history, general morphology and physiology of lichens; Part II of the classification and special morphology of lichens.

The first subject treated is the history of lichenology. This is stated to be in the main "a condensed retrospect of Krempelhuber's *Geschichte der Lichenologie,*" Krempelhuber's book bearing the date of March 1886. Dr. Schneider adds two periods to bring the history up to date: one from Schwendener (1886) to Reinke (1894), the other from Reinke (1894) to the close of 1896. Dr. Schneider admits that Reinke's propositions have not generally been accepted as correct, but maintains that they "are based upon sound argument and should, therefore, mark the beginning of the period in which lichens are recognized as a distinct class of plants; such recognition being based upon physiological considerations."

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[4] SCHNEIDER, ALBERT.—A text-book of general lichenology. Large 8vo., pp. 230, 76 plates. Binghamton, N. Y.: Willard N. Clute & Company. 1897.

The second chapter is devoted to symbiosis. The subject is divided into antagonistic symbiosis (parasitism), nutricism, and mutualistic symbiosis. Under the latter mutualism and individualism are distinguished, the former characterized by the fact that the symbionts are not wholly dependent upon each other for their existence, while in the latter form at least one of the symbionts is absolutely dependent upon the symbiotic association. The phenomenon of individualism is typically met with in lichens, according to Dr. Schneider, and really forms the basis for Reinke's claim that they should be considered a distinct class of plants. Then follows an interesting discussion of the thallus and apothecium, the structure and function of their different parts, their method of growth, mechanical adaptations, etc.

In the consideration of the reproduction and propagation of lichens, Dr. Schneider contends that the spores are unreliable aids to reproduction, and play only an insignificant part in the maintenance of species, because the spore upon germination may not find the proper symbiont alga and also because in some species the spores are only rarely developed. It is doubtful if his view of the subject will find full acceptance.

The next chapter is devoted to the polyphylogeny of lichens. Five families of fungi are given as probable ancestral groups of fungal symbionts, though the statement is made that it is impossible to study out the ancestral fungal types at present. Nine genera of algæ are given which are known to enter into symbiotic relationship to form lichens.

The system of classification proposed is then discussed. Dr. Schneider begins by the statement that "there is at present no satisfactory natural or artificial system," and then proposes an arrangement into orders, families, genera, and species without further subdivision. One who has worked much with lichens cannot but wonder what he proposes to do with the varieties and subvarieties recognized by all systematic writers on lichens. Will the number of species be indefinitely multiplied or shall we find the description of the species so broad that all the varietal forms may be easily accommodated? Judging from the number of genera recognized the first supposition would be the correct one. The orders recognized are the Ascolichenes, Basidiolichenes and Gasterolichenes, based on the method of spore formation.

As family characters, the probable fungal ancestors, the structure and development of the apothecium and thallus are suggested, with some reference to the spores and algæ. In view of the earlier statement that it is impossible "to study out the ancestral fungal types at present," the use of those fungal types as a basis of classification must be difficult. As generic characters the spore characters are given as of primary importance; then the development of the thallus, the apothecium, the exciple, the color of the apothecial disk, the algæ, and the color of the thallus. A number of genera are based upon algal differences. As to specific characters our author says "in general it may be stated that in the establishment of species all known characters must be considered more or less." Chemical reaction is considered of no importance in distinguishing species.

One turns with considerable interest to Dr. Schneider's application of his principles of classification, and it is inevitable that one should compare his work with the classic work of Professor Tuckerman in the same line. Thirty-four years elapsed between the publication of Professor Tuckerman's *Synopsis* of the Lichens of New England, the other northern states and British America, and his publication of his *Synopsis of the North American Lichens.* During all that time he was occupied more or less exclusively with the study of lichens, so we may be assured that his *Synopsis* represents his mature judgment. His *Synopsis* covers the whole of North America, Dr. Schneider's *Text-book*, the northeastern United States. We find seventy-five genera in Professor Tuckerman's *Synopsis*, while Dr. Schneider recognizes seventy-seven genera. If we deduct the thirteen genera recognized by Professor Tuckerman of which no species are recorded as occurring in the region covered by Dr. Schneider, and the eleven genera recognized by Professor Tuckerman as occurring in that region but of which Dr. Schneider makes no mention, we can better appreciate how the Tuckerman genera have been divided up.

But what of the twenty-six new genera thus established? Some are recognized by Professor Tuckerman as sections under his genera, some as distinct genera by other lichenologists, but many are established on a very slight basis, as for instance *Mallotium*, of which Dr. Schneider says "the essential character which distinguishes this genus from Leptogium is the presence of numerous long, comparatively rigid, gray rhizoids which extend in clusters from the lower surface of the thallus." When the great variability in the development of rhizoids is considered, one is startled to see them made the basis of a genus. Is this so much more scientific than Professor Tuckerman's work, of which our author says "he also issued a work on genera of lichens and their relationships, which is, however, unsatisfactory, because the author did not seem to have any clear conception of genera."

While recognizing the careful work that Dr. Schneider has done, one cannot but regret that he has complicated still further the study of lichens by the proposal of a new system of classification.—CLARA E. CUMMINGS.